



CHAPTER SIX

THE MYSTERIOUS DEATH OF A PHARAOH

In 1157 B.C., the Egyptian pharaoh Ramses V died suddenly from what his scribes called simply “an acute illness.” He was only thirty and had ruled Egypt for just four years.

Mystery surrounds Ramses’s death and burial. Pharaohs were usually interred after seventy days of carefully prescribed mummification procedures, but Ramses’s mummy wasn’t buried for almost two years. What could have caused the delay?

Twentieth-century scientists who have examined the pharaoh’s well-preserved mummy believe they may have found the answer. Inspection revealed a rash of raised pustules—large pimples—on Ramses’s lower face, neck, and shoulders as well as his arms. Such pustules are a typical symptom of smallpox.

Unfortunately, the pharaoh’s physicians left no

written description of his illness. But if he did, in fact, die of smallpox, it would explain why it took so long for him to be embalmed and buried. Corpses of smallpox victims, and even their clothing or bedding, can transmit the disease. So the pharaoh's embalmers might have put off mummifying him until they could be certain his remains were no longer contagious.

Or perhaps the first team of embalmers contracted smallpox themselves, and fear of the disease—or a shortage of embalmers—caused a delay in the mummification.

There is little hard evidence about the origins of smallpox. It probably first became a common disease among humans in ancient Egypt sometime before 1500 B.C. From there it eventually spread throughout the world, causing the deaths of millions. The English historian Thomas Babington Macaulay called it "the most terrible of all the ministers of death."

Smallpox was caused by a virus—but that wasn't discovered until the nineteenth century. Most of the disease's victims acquired the virus as a result of face-to-face contact with an infected person. The sufferer gave off millions of tiny virus particles when he or she sneezed or coughed, and the victim inhaled them.

During the first week after infection, there were no obvious signs of illness. Then, sometime between the

ninth and twelfth days, the first symptoms appeared: high fever, chills, backache, and headache. The victim's temperature might jump to as high as 106° F.

At the end of this stage, four days or so later, the temperature dropped and the patient began to feel a little better. But any relief was only temporary, for the patient soon broke out in the smallpox rash. It usually started on the face, then spread to the chest, the arms, the back, and finally the legs.

Over the next several days, the flat spots of rash gradually turned into raised, blisterlike pustules like those found on the mummy of Ramses V. Some patients looked as if they had been badly burned. Even those who weren't as seriously affected said their skin felt as if it were on fire.

The pustules gave the disease the name by which it was first known in the West: *variola*. This came from the Latin word *varius*, meaning spotted, or from another Latin word, *varus*, meaning pimple. Variola wasn't called smallpox until the early sixteenth century, when another disease, syphilis, spread throughout Europe and the British Isles. Since syphilis in its early stages produced a similar rash, English-speaking people labeled it "the great pox" to distinguish it from variola, which they began to call "the small pox."

After about nine days, the smallpox pustules split open and started to dry up. They formed scabs that

eventually fell off, very often leaving the victim with deep-pitted scars on the face and body. The scars would remain there for the rest of the person's life.

That is, if he or she was lucky enough to survive the disease. In addition to the skin, the virus often attacked the eyes, throat, lungs, heart, and liver. A victim might lose the sight in one or both eyes, or might die from the virus's assault on the internal organs. The majority of deaths occurred late in the second week of the disease, after the pustules had developed, but some victims died even before the rash appeared.

SMALLPOX IN THE FAR EAST

After smallpox became established as an endemic disease in ancient Egypt, it apparently traveled eastward along the trade routes to Persia and India. One of the oldest Indian medical books, written about A.D. 400, describes the outbreak of a disease that sounds remarkably like smallpox:

The pustules are red, yellow, and white and they are accompanied with burning pain. . . . The skin seems studded with grains of rice.

In an attempt to ward off the disease's ravages, the Indians created a smallpox goddess, whom they worshipped for centuries. The goddess's name was Sitala, which means "the cool one." The name suggested that

she had the power to relieve the high fever and hot flashes that accompanied the disease.

Indian art portrayed Sitala as a woman dressed in red, the color of fire, and riding an ass. In one hand she carried a broom to sweep the disease along, and in the other a pot of cool water to soothe its feverish victims.

Indians believed that Sitala had an evil as well as a kindly side. According to the stories they told about her, she was ill-tempered and filled with a desire for revenge against humanity. She attacked children with smallpox more often than adults because in doing so she struck a blow at the future of the community.

Temples dedicated to the smallpox goddess could be found all over India. In them, worshippers prayed, "O kind Sitala, keep away from us!" An annual festival was held on the goddess's feast day. Cooking and other activities requiring heat were avoided on that day, and Indians consumed only cold food and drink for fear of annoying Sitala.

Smallpox was probably introduced into China by the Huns, a fierce race of nomads who invaded the northern part of the country about A.D. 250. As a consequence, the Chinese called the disease "Hunpox."

The new disease spread quickly, and in response the Chinese—like the Indians—invented a smallpox goddess. By worshipping her, the Chinese hoped to lessen

the impact of the disease and save lives. They referred to smallpox pustules as "beautiful flowers" so as not to offend the goddess.

The Chinese believed their smallpox goddess took particular delight in scarring the faces of attractive children. This was most likely to happen, they thought, on the last night of the year. So on that night Chinese children wore ugly paper masks to bed, hoping to trick the goddess into ignoring them.

As added insurance, many children hung empty gourds near their beds on the year's last night. If the goddess entered their rooms, they prayed she would drop her smallpox rash into the gourds instead of depositing it on their skins.

When a Chinese family was struck by smallpox, they set up a drawing or painting of the goddess in their home and made offerings to it. If the patient recovered, this temporary shrine was carried from the home in a specially made paper chair or boat and reverently burned. But if the sick person died, the shrine was torn apart and the spirit of the goddess was driven away from the house with curses.

THE "RED TREATMENT"

There weren't many reports in Europe of a disease resembling smallpox during the first centuries of the Christian era. Then, in A.D. 580 and 581, a deadly illness

that sounds much like smallpox swept across northern Italy and southern France. A French bishop, Gregory of Tours, left an account of this epidemic. In it, he described the corpse of a dead nobleman so covered with pustules that "it appeared black and burnt, as if it had been laid on a coal fire."

However, the bishop could have been describing a severe case of measles, a disease with which smallpox was often confused in ancient times. The two diseases weren't clearly distinguished until early in the tenth century. That was when the well-known Muslim physician Rhazes published the results of his observations at the hospital in Baghdad.

Rhazes's complete and accurate description of smallpox symptoms formed the basis of all medical texts dealing with the disease for the next 700 years. But Rhazes—along with other physicians of the time—had no idea what caused the disease or how to treat it.

If the patient's eyes were affected, Rhazes advised that a lotion be applied that contained, among other things, "the dung of sparrows, starlings, and mice." However, he also urged the physician "to look carefully and frequently into the eye, and if it be painful and red, then omit this treatment for some days."

Since smallpox patients suffered from high temperatures and burning sensations, Rhazes prescribed bleeding to cool the blood. He also recommended

what he called "sweat therapy" to help rid the patient's system of excess humors. (Like the physicians who treated victims of the Black Death, Rhazes had studied and accepted Galen's theory of humors.)

Rhazes also believed that red objects were helpful in treating smallpox patients. It's hard to know where this notion originated. Perhaps it came from the fact that the color red had always been associated with fire and heat. At any rate, Rhazes planted the idea, and later Muslim physicians took it a step further. In the eleventh century, Avicenna advised that a smallpox patient be "wrapped in a woolen cloth of a red color, so that the sight of the red cloth may move the blood to the patient's exterior and hold it there in a moderate heat."

Many European doctors read the works of Rhazes and Avicenna and adopted their recommendations of the so-called "red treatment." When England's young Prince John (a son of Edward II) fell ill with smallpox in 1314, his doctors not only covered him with red blankets and hung red curtains around his bed, but also made him suck the juice of a red pomegranate and gargle with red mulberry wine.

The prince survived, although probably not because of the "red treatment." Hundreds of other people in England died, however, in the smallpox epidemics that swept across the British Isles and western Europe during the 1300s.

Historians think the Crusades were responsible for these epidemics. Between the eleventh and fourteenth centuries, thousands of European Christians journeyed eastward to the Holy Land, where smallpox had long been endemic. There the Christians waged the series of wars known as the Crusades in an attempt to recover the Holy Land from the Muslims. When the Crusaders returned home to Europe, they may well have brought lethal new strains of the smallpox virus with them.

A SCOURGE OF CHILDREN

Unlike the bubonic plague, which spread by a third party—namely, a flea from a plague-ridden rat—smallpox was almost always transmitted directly from one person to another. And this could happen only when the person was actively sick or immediately after death, as possibly was the case with Ramses V.

Moreover, if an infected person survived the disease, he or she would be immune from another attack, usually for life. A person who was immune could not transmit the disease either.

Once smallpox entered a community, it never entirely left it. After a major epidemic, however, there was usually a lull during which only a few scattered cases were reported. Why? Because those who had survived the previous epidemic were immune to the

disease, and the number of people who had never been exposed to it was still small.

Eventually, as more and more children were born, a reservoir of susceptible people would build up again. Then one or two cases could spread quickly through the community, and a new smallpox epidemic would occur. Paris, France, was struck by such an epidemic in 1438. Before it ran its course, 50,000 people reportedly died, the majority of them children under the age of twelve.

The death toll could be even more devastating if smallpox hit a people who had never experienced the disease before. That's what happened when European explorers like Christopher Columbus began to voyage to the New World at the end of the fifteenth century. For along with their ships' cargoes of food, weapons, and other supplies, a few of the Europeans carried with them the deadly smallpox virus.

CHAPTER SEVEN

SMALLPOX CONQUERS THE NEW WORLD

When Christopher Columbus landed on the Caribbean island the Spaniards called Hispaniola, he was welcomed by representatives of the Taino people. More than a million Tainos could be found on Hispaniola in 1492. They lived in large, permanent villages, fished the clear waters of the Caribbean, and harvested abundant crops of beans, maize, and squash.

This pleasant way of life was soon to change for the worse. By 1518, just twenty years after Columbus's arrival in the New World, more than a third of the Tainos were dead. Many had perished while working in the gold-mining camps the Spanish had set up. Others starved because of the disruption of their traditional agriculture. But the majority fell victim to epidemic diseases that they had never been exposed to before

and against which they had no defenses. The greatest killer of all was smallpox.

From Hispaniola, the smallpox virus traveled to the neighboring islands of Puerto Rico and Cuba, killing large parts of the native populations on both. Now it was only a matter of time before it struck the mainland somewhere in the Americas.

In 1519, the Spanish soldier and explorer Hernando Cortés sailed from Cuba to Mexico with a band of 550 men. Mexico was home to the powerful Aztec empire, which was rumored to be extremely wealthy. Lured by the tales of gold and other riches, the Spaniards reached the Aztec capital, Tenochtitlán, in early November.

The Aztecs had achieved a high degree of skill in architecture and engineering. Their capital—now the site of Mexico City—was built on a series of islands in the middle of a large lake. As Cortés and his men advanced toward the city on a broad causeway, they looked ahead in wonder. "We were all struck with amazement by the towers and temples," wrote one of Cortés's lieutenants. "Some of us kept asking ourselves whether what we saw was not all a dream."

The Aztecs and their emperor, Montezuma, thought the Spaniards were descendants of the Aztec god Quetzalcoatl and received them with respect. Cortés, seeing a unique opportunity, put Montezuma

under house arrest and demanded a treasure in gold. The Aztec nobles complied with the Spanish demand, and Cortés attempted to rule the empire through the captive Montezuma.

Up to this point, smallpox and other epidemic diseases had played no part in the Spanish assault on the Aztec empire. Then, in the spring of 1520, another band of Spanish soldiers, this one led by Pánfilo de Narváez, landed on the eastern coast of Mexico. In one of Narváez's ships, according to a priest who wrote an account of the expedition, "there was a black African stricken with smallpox, a disease which had never been seen here before."

The African was probably a slave. Starting around 1510, the Spanish had begun to transport slaves from Africa to the New World. The Africans replaced the dying Tainos as laborers in the gold mines and sugar-cane plantations the Spanish had established on Hispaniola and other Caribbean islands. They also served on occasion in Spanish military expeditions, like the one under the leadership of Pánfilo de Narváez.

When Cortés heard that another Spanish force had landed on the coast, he assembled part of his army, left Tenochtitlán, and moved to put down his rival. Cortés succeeded in doing so, but during the struggle the infected African must have given smallpox to a vulnerable soldier in Cortés's army.

While Cortés was away, the Aztecs rose up in revolt against the Spaniards he had left behind in Tenochtitlán. Cortés raced back to the capital to rescue his colleagues, but the Aztec army still outnumbered the combined Spanish force by more than a hundred to one. Under cover of night, Cortés and his men were forced to flee Tenochtitlán over a bridge composed of abandoned baggage and the bodies of dead soldiers.

It seemed like a total defeat for the Spaniards, but without knowing it, they had left a secret weapon behind. One of the dead Spanish soldiers had smallpox. When the Aztecs examined his body in a search for valuables, they accidentally inhaled the deadly smallpox virus that remained on the soldier's corpse and clothing.

Within a few weeks, the disease spread throughout Tenochtitlán, killing at least a fourth of the capital's population. It claimed huge numbers of the Aztec army and the emperor himself. Then the epidemic widened out to the surrounding countryside. A Spanish priest described its terrible effects there: "As the Indians [of Mexico] did not know the remedy of the disease . . . they died in heaps, like bedbugs. In many places it happened that everyone in a house died and, as it was impossible to bury the great number of dead, they pulled down the houses over them so that their homes became their tombs."

In the meantime, Cortés regrouped his forces and prepared to attack Tenochtitlán again. He returned in August 1521 and easily defeated the weakened Aztec army. After the battle, the Spanish found so many dead lying about the city—victims of smallpox, not the fighting—that they claimed they could not walk through the streets without stepping on bodies. The mighty Aztec empire had been brought low by disease, and it would never rise again.

THE FATE OF THE INCAS

Neither the Spaniards nor smallpox halted their march with the conquest of Mexico. In fact, the disease often traveled faster than the Spanish soldiers. From Mexico, it spread down through Central America and in less than ten years reached the vast empire of the Incas.

At its peak, the Incan empire extended for more than two thousand miles down the western coast of South America. Its capital was Cuzco, located high in the Andes Mountains in what is today Peru. From Cuzco, an elaborate system of roads connected the various parts of the empire and enabled the Incan emperor—who was known as the "Son of the Sun"—to maintain control over his sprawling domain.

When a smallpox epidemic struck Cuzco in 1527, the emperor was on a trip to the city of Quito in the northern part of the empire. Runners from the capital

informed him that the disease had already killed his brother, his sister, his uncle, and many other relatives.

The emperor hurried back toward Cuzco but fell ill himself on the way. Taken to one of his palaces, he realized he was dying. He summoned his followers and said, "My father the Sun is calling me. I shall go now to rest at his side."

The emperor then ordered his followers to seal him with stones inside the palace and leave him to die unattended. After eight days, the followers went in, removed his dead body, embalmed it, dressed it in his finest armor, and carried it on their shoulders to Cuzco for burial. Crowds of people lined the roads to pay their last respects to the emperor as his remains passed by.

Historians estimate that 100,000 people died in Quito alone during the smallpox epidemic that killed the Incan emperor. Among them were some of the nation's highest military and political leaders, including the emperor's chosen successor. Civil war broke out between the ruler's two surviving sons. After a long, bloody conflict, the son named Atahualpa finally emerged victorious in 1532. His triumph was short-lived, however, for at almost the same time the Spanish under Francisco Pizarro invaded the empire.

Pizarro, like Cortés in Mexico, commanded an army of fewer than 600 soldiers and missionaries. But

the Spanish had the advantage of guns, artillery, and horses, none of which were known to the Incas. (An ancestor of the modern horse did once roam the plains of the Americas, but it had become extinct thousands of years before the arrival of the Spanish.)

Through trickery, Pizarro captured the new emperor, Atahualpa, and had him put to death. Then Pizarro and his small band of Spaniards assumed control of the mighty Incan empire. At once they began to exploit its riches, especially the large deposits of gold, silver, and other precious metals.

The Incas might still have regrouped their forces and driven out the invaders. But before they could do so, they were hit by another smallpox epidemic, this one probably brought by the Spanish. As a missionary close to Pizarro commented, "The Indians die so easily that the bare look and smell of a Spaniard causes them to give up the ghost."

Another witness to the epidemic left a description of its effects that sounds remarkably like accounts of the Black Death: "[The Incas] died by the scores and hundreds. Villages were depopulated. Corpses were scattered over the fields or piled up in the houses or huts. . . . The fields were uncultivated; the herds were untended; and the workshops and mines were without laborers. . . . The price of food rose to such an extent that many persons found it beyond their reach. They

escaped the foul disease, only to be wasted by famine."

Some sympathetic Spaniards urged their king to take steps to help the Incas before they all died out. But there was little the king in faraway Spain could do, even if he had wanted to. By the end of the sixteenth century, disease and warfare had reduced the native population of the Incan empire to less than a quarter of its former size.

Smallpox also accompanied the Portuguese when they began to establish colonies in Brazil in the 1500s. Jesuit missionaries made the situation worse by herding the native Indians into settlements where they would be baptized and live as Christians. The crowded conditions in the settlements only helped to spread smallpox among the defenseless Indians.

Like European doctors at the time, the missionaries practiced bleeding as a treatment for smallpox. In their attempts to fend off the disease, they also staged long religious processions in which all the marchers prayed together loudly. However, the processions probably made person-to-person transmission that much easier.

By the middle of the seventeenth century, more than 100,000 Indians were huddled around ten Jesuit missions in Brazil. A smallpox epidemic in 1660 carried off an estimated 44,000 Indians, and another in 1669 killed 20,000 more. As their converts died, the Jesuits

responded by rounding up fresh recruits from the remote interior of the country. John Hemming, an Englishman who wrote about the conquest of the Brazilian Indians, commented: "Some of the Jesuits may have believed that it was better for Indians to be baptized but dead than heathen but alive and free."

ON TO NORTH AMERICA

Before 1600, smallpox was unknown among the 20 million or so Native Americans who lived in what are today the United States and Canada. But these Americans would soon suffer the same fate that befell the Indians of Latin America. Beginning in the early 1600s, Great Britain, France, and Holland established permanent settlements in North America. And with the Europeans came smallpox and other contagious diseases that the Native Americans had never encountered before.

In 1633, a smallpox epidemic struck the Native Americans living near the Plymouth Colony in Massachusetts. Increase Mather, one of Boston's leading Puritan clergymen and an early president of Harvard college, thought the epidemic indicated that God was on the colonists' side. Mather wrote:

"The Indians began to be quarrelsome concerning the bounds of the land they had sold to the English; but God ended the controversy by sending the smallpox

amongst the Indians at Saugust, who were before that time exceeding numerous. Whole towns of them were swept away, in some of them not so much as one Soul escaping the destruction."

The virus soon traveled inland. When it reached the Huron tribe north of Lake Ontario in 1636, "terror was universal," according to the account of a French missionary. "The contagion increased as autumn advanced; and when winter came . . . its ravages were appalling. The season of Huron festivity was turned to a season of mourning."

The Iroquois, who lived in upper New York State and Canada, were also hit hard by smallpox. The governor of Canada described an outbreak among them in 1679: "The small pox desolates them to such a degree, that they think no longer of meeting nor of wars, but only of bewailing the dead, of whom there is already an immense number."

Although they weren't affected as severely as the native population, the North American colonists suffered from smallpox, too. Unlike the situation in Europe, where the disease was always present to a greater or lesser degree in the larger cities, it died out between epidemics in the smaller cities of the American colonies. This only made its impact more shocking when a new epidemic struck.

Boston alone had to withstand six major smallpox

epidemics between 1636 and 1698. Rather than risk infection, those who could left the city at the start of an epidemic—just as city dwellers threatened by the bubonic plague had done three centuries earlier in Europe.

The worst epidemic yet hit Boston in the late spring of 1721. It was brought to the city by two infected sailors on a ship from the West Indies. Health officials quarantined the sailors in a house near the docks, but the disease spread anyway. As Cotton Mather wrote in his diary, "The grievous calamity of smallpox has now entered the town."

Mather, the son of Increase Mather, was pastor of Boston's North Church. A graduate of Harvard, he had thought of becoming a doctor before entering the ministry, and had long been interested in science. His scientific articles on American plants, birds, and snakes had circulated in England and won him a membership in the exclusive Royal Society.

Now, faced with a new smallpox epidemic in Boston, Mather remembered a letter he had read some years before in the journal of the Royal Society. The letter described a method of preventing smallpox that country people in Turkey had used with great success. The method was called inoculation.

CHAPTER EIGHT

INOCULATION: GODSEND OR DANGER?

The theory behind inoculation was not new. For centuries, Chinese doctors had conferred immunity on people by blowing dust from the scabs of smallpox patients up the nostrils of the healthy. This often produced a mild infection in the patient, but from then on he or she was immune to any further attacks of the disease.

Country people in eastern Europe also practiced a similar form of immunization, which they called *buying the smallpox*. But most Europeans and Americans had never heard of the practice until the journal of the Royal Society published the letter that Cotton Mather read. It told how inoculation had been used to help stem an outbreak of smallpox that had struck the city of Constantinople (now Istanbul, Turkey) in 1706.

Soon after the letter appeared, an unusual English-

woman, Lady Mary Wortley Montagu, began to promote the idea of inoculation. Lady Mary, a talented poet and tireless letter writer, was the wife of the British ambassador to Constantinople, then the capital of the Ottoman Empire. She had strong personal reasons for being concerned about smallpox. Her younger brother had died of the disease, and she herself had survived a severe attack that left her without eyelashes and with a badly pockmarked face. She wrote a poem about the experience that began:

In tears, surrounded by friends I lay,
Mask'd o'er and trembling at the sight of day.

In Constantinople, Lady Mary heard of inoculation and described the practice in a letter to a friend in London. "The smallpox, so fatal, and so general amongst us, is here entirely harmless, by the invention of *ingrafting*, which is the term they give it. There is a set of old women who make it their business to perform the operation, every autumn in the month of September, when the great heat is abated."

Unlike the Chinese, the old women of Constantinople scratched the recipient's upper arm and injected the powdered scabs from a smallpox patient in the scratch rather than up the nostrils. As in China, the inoculation caused a mild case of smallpox to develop. Once the person recovered, however, he or she would

usually be safe from the disease forever.

"Every year thousands undergo this operation," Lady Mary went on. "There is no example of anyone that had died in it: and you may believe I am well satisfied of the safety of this experiment, since I intend to try it on my dear little son."

In 1718, without her husband's knowledge, Lady Mary had her five-year-old son inoculated by an old Greek woman. Working alongside the woman was the embassy physician, Charles Maitland. The boy came through the procedure with no ill effects whatsoever. A week later, Lady Mary told her husband about the inoculation, assuring him that their son was "at this time singing and playing and very impatient for his supper."

The Montagu family returned to London a year later, and in 1721 a new smallpox epidemic hit the city. This time Lady Mary decided to have her four-year-old daughter inoculated against the disease. Dr. Maitland performed the operation, which was reported in the newspapers. It was the first professional inoculation to be done in England, and was hailed as a complete success.

Among those who read the reports were members of the British royal family, including Princess Caroline, wife of the Prince of Wales (the future King George II). She had almost lost one of her daughters to smallpox and wanted to have both girls inoculated.

But some British doctors were strongly opposed to

the notion. One, Dr. William Wagstaffe, wrote: "Posterity will scarcely be brought to believe that a method practiced only by a few *Ignorant Women*, amongst an illiterate and unthinking people, should on a sudden, and upon slender experience, so far obtain in one of the most Learned and Polite Nations in the World as to be received into the *Royal Palace*."

To overcome the opposition, Princess Caroline arranged to have Dr. Maitland inoculate six condemned prisoners at Newgate Prison while the king's physicians looked on. All the prisoners survived the inoculation and were granted their freedom as a reward. Then, to be doubly sure, the Princess ordered the inoculation of all the orphans in London's St. James Parish. Only when she saw that the orphans, too, had come through the operation unharmed did the Princess allow her own two daughters to be inoculated by Dr. Maitland. Their recovery put the royal seal of approval on the procedure.

In spite of this, inoculation was still not widely practiced in Great Britain. Some people feared that those who had recently been inoculated and were experiencing a mild case of the disease would spread it to susceptible persons in the community. Others objected to the procedure on religious grounds. Like the people of an earlier age who believed the Black Death was the will of God, they wondered whether inoculating someone with smallpox, or permitting themselves to

be inoculated, would be seen as interfering with God's intentions. Perhaps He would be angry with them.

Some British clergymen played on these worries. In a sermon delivered in 1722, the Rev. Edmund Massey cited Job, who suffered terribly in the Old Testament but never challenged God's tests of him. "The fear of disease is a happy restraint to men," Massey said. "If men were more healthy, 'tis a great chance they would be less righteous. Let the Atheist and the Scoffer inoculate. Their hope is in and for only this life. Let the rest of us bless God for the Afflictions He sends among us, and grant us patience under them."

The resistance to inoculation only made Lady Mary Wortley Montagu work harder to win acceptance for it. She visited patients recovering from the procedure and encouraged more doctors to perform inoculations. She also wrote letters to newspapers advocating the practice. "I shall sell no drugs, nor take no fees, could I persuade people of the safety and reasonableness of this easy operation," she said in one letter. "'Tis no way my interest . . . to convince the world of their errors; that is, I shall get nothing by it but the private satisfaction of having done good to mankind. . . ."

Thanks to the efforts of Lady Mary and other supporters, by 1723 inoculations were being performed successfully on more and more English patients. Lady Mary must have felt vindicated. She wrote to her sister,

"I know nobody that has repented the operation, though it has been very troublesome to some fools, who had rather be sick by their doctor's prescriptions than in health because of an inoculation."

UPROAR IN BOSTON

Meanwhile, in the Massachusetts Colony, Cotton Mather had been waging his own campaign to promote inoculation. In June 1721, he stood in his pulpit and urged Boston's physicians to adopt inoculation as a means of halting the smallpox epidemic that was sweeping the city.

Only one of Boston's ten physicians, Dr. Zabdiel Boylston, responded to Mather's call. Using a sharp toothpick and a quill, Boylston inoculated his six-year-old son, Thomas, and two African-American slaves with pus from a smallpox patient. All three developed mild infections, which left them immune afterward.

Many of Boston's other physicians and ministers, as well as a large part of the populace, were outraged that Boylston had deliberately infected three people with smallpox. Public meetings were held at which inoculation was denounced as a dangerous practice.

As in England, the physicians expressed the fear that patients who had been inoculated would infect others while they were getting over the disease. The Boston ministers sincerely believed that using inoculations to

prevent smallpox would be interfering with God's will.

Tensions mounted to such a pitch that Dr. Boylston had to hide in his house for two weeks after an angry crowd threatened to drag him out and hang him. Someone threw a homemade grenade into Cotton Mather's house, but it failed to explode. Attached to the grenade was a note that read, "Cotton Mather, you dog. Damn you! I'll inoculate you with this, and a pox to you!"

As the months passed, the mood of the city calmed down somewhat. Dr. Boylston resumed his inoculations and two other doctors joined him in performing them. Cotton Mather answered the charges of other ministers by preaching that God must be in favor of inoculation since it saved lives. But there were still loud rumblings of protest against the activities of both men.

The controversy surrounding inoculation was brought home to Mather in a very personal way when his son Samuel asked that he be inoculated. Samuel's roommate at Harvard College had died painfully of smallpox, and Samuel feared he might contract the disease.

Cotton Mather didn't know what to do. If he refused to let his beloved son be inoculated, and Samuel died of the disease, how could Mather forgive himself? "On the other hand," Mather wrote, "our People . . . will go on with infinite Prejudices against me and my

Ministry, if I suffer this Operation upon the child."

In the end, Mather's feelings for his son outweighed his worries about his reputation, and Samuel was inoculated by Dr. Boylston. The young man made a speedy recovery, and proved to be a wonderful living advertisement for the inoculation process.

When the smallpox epidemic in Boston finally came to an end in the spring of 1722, it was revealed that Dr. Boylston and his two colleagues had inoculated 280 patients. Only six of them died from the disease—a little more than two percent. On the other side, out of a preepidemic population of 11,000, more than 5800 uninoculated Bostonians had come down with smallpox, and 844—or fifteen percent—had died. This seemed to prove beyond a doubt the benefits of inoculation.

After its successful use in Boston, inoculation was employed to help fight smallpox epidemics in Philadelphia, New York City, and Charleston, South Carolina, during the 1730s. Nowhere did the practice generate the kind of controversy it had aroused in Boston.

Benjamin Franklin, then the editor of the *Pennsylvania Gazette*, promoted inoculation in Philadelphia, and the city became a center for the treatment. Patients from all the American colonies and the West Indies, too, traveled to Philadelphia to be inoculated.

The well-to-do often made inoculation into a social occasion. Entire families, or groups of good friends,

would arrange to be inoculated together and share the one or two weeks of required isolation afterward. Abigail Adams took her four children to the home of an aunt in Boston for their inoculations. There they recuperated together while her husband, John Adams—who was to become the second President of the United States—attended the First Continental Congress in Philadelphia.

Because inoculation was quite an expensive procedure, Benjamin Franklin and others urged that ways be found to make it available to the poor as well as the rich. Responding to their call, Philadelphia established the Society for the Inoculation of the Poor in 1774. Through the efforts of the Society and similar organizations elsewhere, the death rate from smallpox dropped sharply in the cities along the eastern seaboard during the later years of the eighteenth century.

One group of Americans was overlooked as the colonies moved to adopt inoculation on a wider scale. These were the members of the Native American tribes who lived in the vast region beyond the colonies' western boundaries. In fact, far from trying to control smallpox among Native Americans, the settlers sometimes plotted to spread the disease among them.

The most notorious example of this occurred in 1763. That was when Sir Jeffrey Amherst, commander-in-chief of British forces in North America, became

alarmed by Native American attacks on his troops as the British moved westward.

In a letter to one of his colonels, Amherst made a drastic suggestion: "Could it not be contrived to send the smallpox among these . . . tribes of Indians? We must on this occasion use every stratagem in our power to reduce them."

The colonel replied: "I will try to inoculate [infect] the Indians with some blankets that may fall in their hands, and take care not to get the disease myself."

Amherst was all in favor of the colonel's plan. "You will do well to try to infect the Indians by means of blankets," he wrote, "as well as to try every other method that can serve to extirpate this execrable race."

Shortly thereafter, the colonel invited two Native American chiefs to the British camp. He told the chiefs he wanted to resolve the tense military situation that existed between the two groups. An officer who was present revealed the true purpose of the meeting in his diary. "Out of our regard for [the chiefs] we gave them two blankets and handkerchiefs out of the smallpox hospital. I hope they will have the desired effect."

It is not known for certain whether they did or not. But Native American resistance to the British and American forces weakened noticeably in the next few months, and it may well have been due to the colonel's poisonous "gift."

SMALLPOX IN THE AMERICAN REVOLUTION

During the American Revolution, which began in 1775, smallpox was a bigger problem for the American army than it was for the British. More British soldiers had had the disease, naturally or through inoculation, and thus more of them were immune to it.

The American leader, General George Washington, was well aware of the damage smallpox could do. He himself had survived an attack while visiting his brother on the island of Barbados in 1751, but it had left his face pockmarked. Now, not wanting to lose any of his soldiers to the disease, General Washington moved cautiously.

When the British gave up Boston in 1776, Washington at first would let only a thousand American soldiers who had already had smallpox enter the city. He was worried that his other soldiers might contract the disease from contaminated objects—sheets, towels, etc.—that the British had left behind.

At first Washington and the other American commanders were hesitant to launch a major campaign to inoculate American soldiers. They feared the soldiers would spread the disease to their fellows while they were in the contagious phase. Eventually, Washington changed his mind about mass inoculations. He decided the risk was worth it if the health of most of his men could be preserved. "I would fain hope," Washington

wrote, "that in a short space of time we shall have an army not subject to this, the greatest of all calamities that can befall it."

From all the evidence, Washington's inoculation policy worked. Although the American army suffered many setbacks, it was never laid low by a major smallpox epidemic. And it finally triumphed over the British at the battle of Yorktown, Virginia, in 1781.

As inoculation became more commonplace in Europe and America, the death rate from smallpox continued to decline. Epidemics broke out occasionally, however, hitting large, crowded cities like London especially hard. The majority of the victims were young, poor children who had not been inoculated. In some English cities, such as Manchester and Birmingham, nine of every ten persons who died of smallpox were under five years old.

A French doctor in the late 1700s estimated that, despite the widespread use of inoculation, one fourth of the human race was still being killed, blinded, or disfigured for life by smallpox. But a new means of prevention was about to be discovered, one that would bring the disease under control at last. This was vaccination.

CHAPTER NINE

DR. JENNER'S MARVELOUS VACCINE

When Edward Jenner was eight years old, he had a painful experience that he never forgot. Later, it helped inspire him to seek a safer and more efficient means of preventing smallpox.

Edward was the younger son of the rector of a little church in Berkeley, in the western English county of Gloucestershire. Both his parents died when Edward was five, and his older brother, Stephen—a minister like their father—took charge of Edward's upbringing.

Stephen was well-read and open to new scientific ideas like inoculation. So when a smallpox epidemic broke out in Gloucestershire in 1757, Stephen arranged to have his younger brother inoculated with a number of other children.

The inoculations were to be administered by a local pharmacist in a stable that he owned. First, though, the

man bled Edward and the other children repeatedly over a period of six weeks—a procedure that dated to the time of the Black Death and even earlier. The pharmacist also gave the children large doses of laxatives to empty their stomachs.

At last the day for the inoculations arrived. Edward, like the other children, lay on a table while the pharmacist scratched his left arm with the tip of a knife, placed the dried scab from a smallpox victim over the cuts, and bandaged the arm. Edward could not go home afterward. Instead, he and the other children were forced to stay in the stable until the pharmacist judged they were no longer contagious.

After about a week, Edward, like most of the others in the stable, came down with a mild case of smallpox. His temperature soared and the characteristic rash appeared on his skin. Within three days, though, his temperature went down and the rash gradually faded away.

Shortly thereafter, the pharmacist told Edward he could go home to his brother. As he unlocked the stable door, the man clapped Edward on the shoulder and said he was now immune to any future attack of smallpox. But it took the boy almost a month to recover fully from the disease and the bleeding and purging that had preceded it.

From early childhood, Edward had shown an interest

in nature and science. Sensing this, his brother Stephen arranged for him to become, at age thirteen, an apprentice to a physician in a nearby town. It was while helping Dr. Daniel Ludlow with his work that Edward first heard farm people say that they could not get smallpox because they had already had the cowpox.

Cowpox, a relatively mild disease of cattle, usually caused a few blisters on the udders of infected cows. Milkmaids and other farm workers could acquire the disease when they milked sick animals. Painful sores broke out on their hands and sometimes left scars, but the disease soon passed and—unlike smallpox—was not fatal.

Young Jenner was intrigued by the stories he heard about cowpox providing its human victims with an immunity to smallpox. But Dr. Ludlow pooh-poohed them, saying there was no evidence of a connection between the two diseases.

When Edward had learned all he could locally, his brother sent him to London to study medicine with a prominent doctor there. Edward did so well that his teacher offered him a permanent position, but Edward decided he would rather return to his hometown of Berkeley to practice. In 1773 he converted a room in his brother's house into an office and set himself up as the town's only physician.

A new smallpox epidemic struck Gloucestershire in

1778. As Jenner traveled around the county giving inoculations, he was often reminded of the stories about cowpox that he had heard as a boy. Many farmworkers whom Jenner approached flatly refused to be inoculated. They told him they had already had the cowpox, and that it prevented smallpox. So there was no need to give them inoculations.

The farmworkers' stubborn resistance made Jenner think they might be right. Over the next several years, he spent much time studying cowpox. He went to one dairy farm after another, looking for cases of the disease. Some of the farmers welcomed him, others thought he was odd or maybe even a little crazy.

During his investigations, Jenner discovered that cowpox protected a person against smallpox only if he or she caught the disease when it was at its height in the infected animal. A day or two earlier or later, and the ease of cowpox that resulted would be too weak to provide immunity.

He also got the idea that it might be possible, as with smallpox, to infect a person with a mild case of cowpox by inoculation. He thought this could be done first with disease-laden matter from a cow. Then matter from a sore on the infected person could be used to inoculate other humans. But it wasn't until 1796 that he was able to test his theories.

In May of that year, a local milkmaid named Sarah

Nelmes cut her finger on a thorn just before milking a cow that was suffering from cowpox. Soon, a large, pus-filled sore appeared on Sarah's finger, followed by two smaller ones on her wrist.

The young woman went to Dr. Jenner for treatment, and he realized that her infection was nearing its peak. This was the chance he had been waiting for. After reassuring Sarah that she would recover, he asked her to come back in a few days, when he estimated the cowpox sores would be at their worst.

In the meantime, Dr. Jenner sought out an eight-year-old boy, James Phipps, who had never had either cowpox or smallpox. Although he could not guarantee the boy's safety, Jenner obtained the permission of James's parents to conduct an experiment on their son.

When Sarah returned to Jenner's office, James Phipps was waiting there with the doctor. First Jenner took some pus from the sore on Sarah's finger. Then, after making two small scratches on James's left arm, the doctor inserted the pus in the cuts. Afterward, he sent both James and Sarah home. There was no need for the boy to be isolated, as Jenner once had been, since cowpox could not be transmitted from one human being to another.

Jenner checked on James's condition every day. "On the ninth day," the doctor wrote, "he became a little chilly, lost his appetite, and had a headache. . . . [He]

spent the night with some degree of restlessness, but on the day following he was perfectly well."

Now came the risky part of the experiment. On July 1, Jenner repeated the inoculation procedure on James Phipps, this time with matter from a smallpox patient. How would James react? Jenner thought the earlier cowpox infection would render the boy immune to the smallpox, but he couldn't be sure.

Happily, Jenner was proved right. On July 19, he reported on the results of the experiment in a letter to a friend: ". . . But now listen to the most delightful part of my story. The Boy has since been inoculated for the Smallpox which as I ventured to predict produced no [ill] effects [whatsoever]. I shall now pursue my Experiments with redoubled ardor."

The following year Jenner submitted a brief article to the Royal Society describing his experiment on James Phipps. However, it was returned to him with a note from the editors saying they found his evidence too thin. They also thought it most unlikely that anyone would believe cowpox could be used to prevent smallpox.

Jenner did not let this rejection from the Society stop him. He continued his experiments and, in 1798, inoculated five more children with cowpox. Later he followed up by inoculating three of the children with smallpox, and none of them became ill.

Jenner was now more convinced than ever that his theories were correct. He wrote a pamphlet summarizing his findings, and this time he published it himself instead of trying to go through the Royal Society. In the pamphlet, Jenner called the matter he had taken from the cowpox sore a *vaccine*, from the Latin for *obtained from a cow*. The process itself he called *vaccination*, to distinguish it from inoculation. Now the word *vaccination* is used for any immunization process that protects against a particular disease, and vaccines are obtained from many different sources.

Other English doctors read Jenner's pamphlet and conducted successful experiments of their own. Many of them published accounts that lent further support to his theories. Edward Jenner was elated. In a letter to a colleague, he predicted that "the annihilation of smallpox—the most dreadful scourge of the human race—will be the final result of [vaccination]."

The good news about vaccination traveled far beyond the borders of England. Within a few years, Jenner's pamphlet had been translated into German, French, Spanish, Dutch, and Italian. Copies of the English edition were shipped across the Atlantic to the newly independent United States.

In many places, vaccination soon replaced inoculation as the preferred method of preventing smallpox. Vaccination was simpler and cheaper than the earlier

treatment, since patients did not have to remain isolated for one or two weeks after being vaccinated. It was safer, too, because cowpox was a much less severe disease.

Not everyone approved of vaccination, however. A British surgeon named John Birch feared it would eliminate a disease that he called "a merciful means of reducing the country's poor population." Some religious leaders opposed vaccination on the familiar ground that it interfered with God's will. But many other ministers and priests endorsed the practice. In Geneva, Switzerland, one minister even permitted a doctor to hand out literature promoting vaccination when parents brought their babies to be baptized.

VACCINATIONS AND EPIDEMICS

Dr. Benjamin Waterhouse did more than any other individual to spread the word about vaccination in the United States. Waterhouse was a Quaker who had studied medicine in England, Scotland, and Holland before returning to Newport, Rhode Island, to set up a practice in 1781. English friends sent him copies of Jenner's writings on the cowpox vaccine.

Dr. Waterhouse recognized the importance of Jenner's discoveries and gave a talk about them at a meeting of the American Academy of Arts and Sciences. Then Waterhouse proceeded to put Jenner's theories to the test by vaccinating his own five-year-old son,

David, and six other members of his household. These were the first vaccinations performed in the United States.

Later, Dr. Waterhouse inoculated David and the others with smallpox, and all of them resisted infection. As with James Phipps in England, vaccination had made them immune to the disease.

Waterhouse performed more vaccinations in New England and published accounts of the results. In 1801, he wrote to President Thomas Jefferson, asking his help in promoting vaccination throughout the country. Jefferson wrote back: "I had before attended to your publications on the subject in the newspapers, and took much interest in the result of the experiments you were making. Every friend of humanity must look with pleasure on this discovery [vaccination], by which one more evil is withdrawn from the condition of man."

With Jefferson's backing, vaccination was introduced in Washington, Baltimore, Philadelphia, and New York City. Jefferson also explained the new preventive measure to a group of Native Americans who had gathered in Washington. The President brought in a doctor to vaccinate the tribesmen and gave them a supply of vaccine to take home, along with instructions on how to use it.

Many Native Americans were suspicious of vaccination, however. George Catlin, an artist who studied

and painted the tribes of the Midwest, suggested why Native Americans felt this way. "They see the white men urging the operation [vaccination] so earnestly they decide it must be some new . . . trick of the pale face by which they hope to gain some new advantage over them."

Their suspicions had fatal consequences for several tribes when two great smallpox epidemics swept the Midwest. The first struck the region in 1801–2 and the second between 1836 and 1840.

Both epidemics were accidentally triggered by white traders as they journeyed up the Missouri River by boat. It took only one or two infected crewmen to spread the disease among thousands of Native Americans living along the river. Like the Aztecs in Mexico, the Incas in Peru, and their own fellows in the eastern United States, these peoples had never been exposed to smallpox before and had no defenses against it.

The second epidemic lasted much longer than the first and claimed far more lives. It raged across vast areas of the West and virtually wiped out an entire tribe, the Mandans, who lived in what is now North Dakota.

The Mandan population numbered about two thousand men, women, and children when an American Fur Company steamboat approached their settlement on the bank of the Missouri in June 1837. The steamboat captain knew that two of his sailors were ill with small-

pox, but that didn't prevent him from stopping at the settlement to trade. The tribal chiefs came on board to welcome the captain and get a preview of his wares. They were infected unintentionally by the sick sailors, and carried the disease back to their own people. Within days, countless Mandans fell ill.

"There was but one continual crying and howling and praying to the Great Spirit for his protection," George Catlin wrote later in his journal. Catlin was not present in the Mandan village during the epidemic, but heard what happened there from a white trader stationed at nearby Fort Clark.

"Nobody thought of burying the dead," Catlin went on. "Whole families together were left in horrid and loathsome piles in their own wigwams, with a few buffalo robes thrown over them, there to decay, and be devoured by their own dogs."

The disease spread to other tribes in the same epidemic, among them the Blackfeet, Cheyennes, and Crows. Major Joshua Pilcher, then the Superintendent of Indian Affairs at St. Louis, estimated that at least 25,000 members of these tribes died within four or five months.

As for the Mandans, only thirty or forty of the original two thousand survived the epidemic. Dazed and grief-stricken, they were enslaved by the Riccarees, an enemy tribe living two hundred miles south on the

Missouri. The Riccarees moved up and took possession of the Mandans' village because it was better built than their own.

Although there is no evidence that they were started deliberately, the smallpox epidemics of the early nineteenth century furthered the expansionist goals of the young United States. By weakening the Native American tribes of the Midwest and West, the epidemic made it easier for the United States to lay claim to western land. Meanwhile, new advances were being made throughout the world in the ongoing struggle against the disease. Several of them concerned improvements in the vaccination process.

British doctors realized that vaccinations did not always provide lifelong immunity when some people who had been vaccinated developed mild cases of smallpox a few years later. To counter this tendency, the doctors recommended that the average person be revaccinated every seven to ten years. The new policy was introduced in Great Britain and elsewhere in 1829 and made vaccination an even more reliable safeguard against smallpox.

As time went on, it was found that arm-to-arm vaccination from one human being to another could sometimes be dangerous. If the donor was infected with a disease besides cowpox, he or she might transmit it to

the recipient along with the vaccine. This problem was solved when a scientist in Italy discovered a way to produce a steady supply of high-quality vaccine in cattle. Now there was no need for an infected person like Sarah Nelmes to be used as a source of cowpox vaccine.

By the middle of the nineteenth century, vaccination had won acceptance in many parts of the world. Massachusetts passed a law in 1855 requiring that all schoolchildren be vaccinated, and New York and other states soon followed its example. England banned inoculation in 1842 and decreed in 1853 that all its citizens be vaccinated instead.

Not everyone was in favor of these new laws. Some saw them as example of government interference with matters that should be left to individual or family choice. Others were simply afraid of being vaccinated. The English humor magazine *Punch* poked fun at these fears when it published the following poem in 1881. It was patterned on the famous soliloquy "To Be or Not to Be" from Shakespeare's play *Hamlet*.

To vaccinate or not, that is the question!
Whether 'tis better for a man to suffer
The painful pangs and lasting scars of smallpox,
Or to bare arms before the surgeon's lancet,
And by being vaccinated, end them. Yes!
To see the tiny point, and say we end

The chance of many a thousand awful scars
That flesh is heir to—'tis a consummation
Devoutly to be wished. . . .

As the nineteenth century neared its end, more and more people followed the advice of the poem's narrator and got vaccinations. Germany enacted a law requiring all German children to be vaccinated before their second birthday and revaccinated at age twelve. Enforced strictly, the law virtually eliminated smallpox as a public health problem in Germany.

Similar laws in other countries showed equally positive results. Taken together, they made it seem as if Edward Jenner's optimistic prediction would be proved correct. Vaccination might really bring about the annihilation of smallpox.

CHAPTER TEN

THE END OF SMALLPOX?

Starting in the 1890s, one country after another reported that vaccination campaigns had wiped out smallpox within its borders. Sweden was the first, in 1895. Puerto Rico initiated an island-wide effort that eliminated the disease in 1899. It vanished from Great Britain, the Philippine Islands, and the Soviet Union in the 1930s.

The United States moved more slowly to eradicate the disease. Some Americans refused on religious grounds to have themselves or their children vaccinated, while others saw compulsory vaccination as an infringement of their civil rights. This led a highly respected scientist, Dr. C. V. Chapin, to state in 1913 that the United States was "the least vaccinated of any civilized country." But the situation gradually improved, and by the late 1940s the United States, too,

was free of smallpox. Then came one last, alarming outbreak of the disease in New York City.

In March 1947, an American businessman who had been working in Mexico City got off a bus in New York feeling ill. Taken to a hospital, he was diagnosed as having acute bronchitis. Only after the man died did his doctors realize that he had actually been suffering from smallpox.

The man had come into contact with a number of people while on the bus and in the hospital, and two of them fell ill with the disease also. The media took up the story, and a smallpox scare ensued. New Yorkers feared the city might be swept by a full-scale epidemic.

City health officials responded by announcing a mass campaign to vaccinate or revaccinate everyone who lived in New York. With the help of the Army and Navy and teams of doctors, the campaign was set in motion. By April 20, just a little more than a month after the businessman fell ill, more than 3,450,000 New Yorkers had been vaccinated and no new cases had been reported in a week. The smallpox scare ended as swiftly as it had begun.

Inspired by success stories like this, and the fact that smallpox had been wiped out in most of the industrial countries, a movement began in the United Nations to rid the entire world of smallpox. Two new advances in vaccination made this goal seem possible

for the first time. One was a more efficient needle for mass vaccinations. The other was a way of freeze-drying vaccine so that it would retain its potency for months without refrigeration in almost any climate.

With these tools in hand, the World Health Organization (WHO) of the United Nations adopted an ambitious resolution in 1966. It called for the final eradication of smallpox through the combined efforts of all member nations, and set January 1, 1977, as the deadline for this to be accomplished.

At the time the resolution was passed, forty-four countries were still reporting cases of smallpox, and the disease was endemic in thirty-three of them.

Those involved with the eradication program faced many challenges as they prepared to launch their worldwide campaign. Most crucial was the need to prove that smallpox could be wiped out in poorer countries whose transportation systems, sanitation facilities, and health services all tended to be inadequate.

Ways to overcome these hurdles were discovered out of sheer necessity during the eradication campaign in the west African country of Nigeria. Until then, the standard policy had been to conduct mass vaccinations of entire populations. But when an expected shipment of vaccine failed to arrive in Nigeria, the local advisor, Dr. William Foege, had to make do with the limited supply he already had on hand.

Dr. Foege decided on a new policy that he called "surveillance and containment." Instead of performing mass vaccinations throughout the country, he and his staff waited until an outbreak of smallpox was reported in a particular household or village. Then they traveled to the place and vaccinated only those people in the vicinity who might have been exposed to the disease.

Dr. Foege's policy was so successful in Nigeria that other African eradication teams adopted it. As a result, smallpox was completely eliminated in twenty west and central African countries in less than three and a half years.

The surveillance-and-containment policy was equally successful elsewhere. Brazil—the only country in the Americas where smallpox was still endemic—became free of the disease in 1971. Indonesia reported its last case in January 1972. By the end of 1972, outbreaks of smallpox continued to occur in just six countries—four in Asia, including India, and two in east Africa. A terrible epidemic killed more than 25,000 people in India in the spring of 1974.

Health workers in India had to overcome numerous obstacles as they struggled to bring smallpox under control. Worshippers of the Indian smallpox goddess, Sitala, feared that she would vent her anger on them if they allowed themselves to be vaccinated. The health workers had to convince these believers that

the goddess would approve of vaccination.

When necessary, the workers made house-by-house searches for smallpox cases. If they found any, they vaccinated everyone within a three-mile radius of the infected family. In the meantime, the disease victims had to remain isolated in their homes, like victims of the bubonic plague in seventeenth-century London, until they were no longer contagious.

India's beggars, some of them professionals, presented a special problem. The beggars often traveled from village to village, and those infected with smallpox spread the disease as they went. Moreover, sick beggars refused to be isolated, saying they would have no income if they left the streets. So health workers came up with a practical solution to the problem: They offered to provide the beggars with food and shelter until the isolation period was over.

By late 1974, 236 specialists in epidemic diseases from thirty nations were contributing their knowledge and experience to the eradication campaign in India. Working closely with them were thousands of Indian specialists and health workers. As a result of their joint efforts, the number of new smallpox cases declined sharply throughout the country in the early months of 1975. Then came the day all the specialists and health workers had been waiting for. On July 4, 1975, the last person in India to suffer from smallpox was released

from an isolation hospital and returned to her home.

Now new cases of smallpox were being reported only in two east African countries, Ethiopia and Somalia. The disease was eliminated in Ethiopia by 1976, but it persisted among the nomadic peoples of Somalia. When an outbreak occurred, these Somalis did not want to be confined in their tiny huts or in large, remote isolation camps run by the government.

Health workers in Somalia came up with a solution to the problem that was similar to the one used with the beggars in India. Special isolation areas were created near nomadic encampments where smallpox had broken out. Each area consisted of a hut of wood and thatch and a surrounding fence made of thorn bushes. Guards were posted at the only gate in the fence to make sure no one entered or left.

A cook was assigned to the area and given better food to prepare for the smallpox sufferers than they were likely to get outside. When the sufferers recovered and were released from isolation, each of them received new clothing, a gift of the World Health Organization.

Once this isolation policy was put into practice, it brought quick results. Victims of the disease were no longer reluctant to be confined, and on November 28, 1977, the last known smallpox sufferer in Somalia left an isolation area and rejoined his family.

TO PRESERVE OR DESTROY?

The World Health Organization did not claim immediate victory in the eradication campaign. Instead it sent observers to countries where smallpox had been endemic to make sure it was really gone. While this search was going on, the disease made one last, deadly appearance in a country where it had long been absent.

In September 1978, a small amount of smallpox virus escaped accidentally from a research laboratory in Birmingham, England. It infected a medical photographer named Janet Parker and her aged mother. The mother survived, but Parker died. So did the head of the laboratory, who felt so guilty about the incident that he took his own life.

A year later, in 1979, the World Health Organization made a long-awaited announcement. The results of its survey were in and the word was that smallpox—the disease that had killed millions of people over more than three thousand years—had been totally eliminated from the Earth.

In light of this happy development, WHO recommended that vaccinations against smallpox be stopped everywhere. The United States and other countries had ceased routine vaccinations of children and travelers in the early 1970s, but the armed forces of several nations, including the United States and the Soviet Union, were still being vaccinated.

Scientists and health workers throughout the world rejoiced at WHO's announcement. At the same time, they remembered what had happened in Birmingham and worried about the stockpiles of smallpox virus that laboratories in many nations possessed. Might the disease come back to frightful life if similar accidents occurred at one or more of these laboratories?

Responding to the scientists' concerns, some nations voluntarily destroyed their stocks of the smallpox virus. Others handed them over to research centers in the United States and the Soviet Union, depending on which superpower they were closer to politically. By the late 1980s only six hundred tiny vials of smallpox virus remained. All of them were frozen in liquid nitrogen and were handled only by scientific workers wearing special protective suits.

The U.S. Centers for Disease Control (CDC) stored four hundred of the vials at a laboratory in Atlanta, Georgia. The other two hundred vials were kept in a special freezer in Moscow, the capital of the Soviet Union, and were watched over by a regiment of army officers.

In 1990 the World Health Organization urged that the last two stocks of smallpox virus be destroyed. The organization, expressing the anxieties of many member nations, feared what would happen if the virus were used in biological warfare or if it somehow got into the hands of terrorists.

First the United States and then the Soviet Union decided to support WHO's position. December 31, 1993, was set as the deadline for the final destruction of the virus stocks, probably by heating them to a very high temperature. By that date, WHO thought, scientists in both countries would have completed their studies of the virus and how it worked.

As the deadline neared, arguments went back and forth in political and scientific circles. On the one hand were those who believed the sooner the virus was destroyed, the better, so that smallpox would never again be a threat to humanity. On the other were the scientists who said they needed more time to study the structure of the virus. They contended that a better understanding of the smallpox virus might provide clues that would help in the struggles against other scourges, such as cancer, inherited genetic diseases, and even some forms of heart disease.

WHO decided in favor of the scientists who wanted the virus's destruction to be delayed. December 31, 1993, came and went and the vials of virus stayed in their closely guarded freezers in Atlanta and Moscow. In June 1994, WHO extended the reprieve for another year, until the end of May 1995. Later in 1994, a ten-member committee of WHO recommended unanimously that the smallpox virus be destroyed once and for all on June 30, 1995.

There were still some scientists who favored preserving the virus, however. They pressured the executive board of WHO, which failed to approve its own committee's recommendation that the virus be destroyed. Thus the smallpox virus was given at least another one-year stay of execution, until June 1996. And the postponement could be indefinite.

Meanwhile, another deadly virus had captured the world's attention, one for which an effective treatment—let alone eradication—was nowhere in sight. This, of course, was AIDS.